
Rule WLM053: The number of page slots allocated may not be sufficient for effective block paging

Finding: CPExpert has determined that the number of page slots allocated to local page data sets may not always allow the Auxiliary Storage Manager to implement the contiguous slot algorithm. **This finding relates to the block paging algorithms.**

Impact: This finding can have a LOW IMPACT, MEDIUM IMPACT, or HIGH IMPACT on performance of your computer system. The level of impact depends upon how many block pages are directed to auxiliary storage or are migrated to auxiliary storage.

Logic flow: The following rule causes this rule to be invoked:
Rule WLM400: Page-in from auxiliary storage was a major performance problem

Discussion: Prior to SP4.2, the Real Storage Manager (RSM) would steal a limited number of frames from any address space (the limit would be either 2 or 10 frames, depending upon system conditions). With SP4.2, the limit on the number of frames stolen from an address space has been removed.

The Page Steal Routine (IRARMPR5) in the System Resources Manager (SRM) sets the **target** number of frames to steal as a function of the number required to replenish the Available Frame Queue (that is, it takes as many frames as are required to reach the RCEAFCOK value). The RSM uses the target to steal pages based upon UIC. Thus, for a given UIC value, the RSM will steal up to the target number of frames from a single address space.

Additionally, the Page Trim Routine (IRARMPR9) in the SRM will trim pages from swapped out address spaces based upon the UIC.

The frames stolen or trimmed from an address space at a given UIC are moved to expanded storage or to auxiliary storage as a block, **if the pages are contiguous in virtual storage**. The RSM maintains information about the pages in a block, when the block is formed.

If the block is moved to auxiliary storage (either directly or migrated from expanded storage), the RSM requests that the contiguous slot algorithm be used. Thus, the Auxiliary Storage Manager will place the block into contiguous page slots on auxiliary storage if contiguous slots are available.

If the contiguous slot algorithm is successful in locating contiguous slots, only one seek is required to write the block. Additionally, there would be no latency between page writes. The effect of the contiguous slot algorithm is to minimize the device service time per page and to minimize the device utilization.

When a page fault subsequently causes a page in the block to be retrieved from auxiliary storage, all pages in the block **following the page referenced** will be brought into storage, in anticipation that these pages might also be referenced. The rationale for this is that there may be a high probability that other pages in the block will be referenced once any page in the block is referenced. Recall that a block consists of contiguous pages at the same UIC. If other pages at the same UIC are referenced, page fault resolution from auxiliary storage can be avoided if the remainder of the block is brought into central storage.

The contiguous slot algorithm is effective only if there is a sufficiently large number of slots allocated to local page data sets so that fragmentation of the data sets does not preclude the ASM finding contiguous slots. As a general guidance, the number of slots **allocated** should be at least four times the number of slots actually **used**.

CPEXpert analyzes the number of slots allocated to local page data sets, versus the number of slots in use. This analysis is based upon information contained in SMF Type 75 records (SMF75SLA and SMF75MXU, respectively). Additionally, CPEXpert verifies that blocked pages were written to auxiliary storage.

Rule WLM053 is produced if the number of slots allocated for local page data sets is not four times the number of slots used and if some service class missed its performance goal because of page-in or swap-in delays.

The performance benefits of block paging from auxiliary storage are defeated if the contiguous slot algorithm is not effective.

The following example illustrates the output from Rule WLM053:

RULE WLM053: THE NUMBER OF ALLOCATED PAGE SLOTS MAY BE INSUFFICIENT

The number of slots allocated for local page data sets may not always allow the Auxiliary Storage Manager to implement the contiguous slot algorithm for block paging. During the measurement intervals shown below, the number of available slots was less than the desired percent of slots allocated, and at least one service class missed its performance goal because of paging delays from auxiliary storage. As a general rule, the number of allocated slots should be about 4 times the average number of slots used to ensure that the contiguous slot algorithm has sufficient space.

MEASUREMENT INTERVAL	AUXILIARY STORAGE	SLOTS	PERCENT
	SLOTS ALLOCATED	USED	SLOTS USED
7:30- 8:00, 16AUG1995	36,000	16,427	45.6
8:00- 8:30, 16AUG1995	36,000	16,090	44.7

Suggestion: CPExpert suggests that you consider increasing the number of slots allocated to local page data sets so that the contiguous slot algorithm can be effective.

Reference: MVS/ESA SP4.2 Working Set Management and Block Paging Presentation Guide, GG66-3204, pages 50-53.

MVS/ESA SP4.2 Program Code, LJB2-9605, routines IRARMPR5 and IRARMPR9 of module IRARMPRP.

Please note that while these references apply to MVS/ESA SP4.2, the finding is generally applicable after SP4.2.

"Paging Analysis in an Expanded Storage Environment", Beretvas, Thomas (IBM Corporation), *CMG '87 Conference Proceedings*, The Computer Measurement Group, Inc., Chicago, IL.

"Central Storage Management with MVS/ESA", Deese, Donald R. (Computer Management Sciences), *CMG '93 Conference Proceedings*, The Computer Measurement Group, Inc., Chicago, IL.

"Expanded Storage Management with MVS/ESA", Deese, Donald R. (Computer Management Sciences), *CMG '93 Conference Proceedings*, The Computer Measurement Group, Inc., Chicago, IL.